

“Self-Sustaining Ecosystems”

[ Sergei: A Story ]

10/11/2010 – 10/19/2010

Advanced Placement Environmental Science

## I. Background

Ecosystems, natural units that consist of living and non-living parts which interact, are the building blocks of the world. Each ecosystem, however, is not isolated, it, in turn, interacts with other ecosystem to create a network that sustains life all around the planet. This experiment focuses on studying that interaction between ecosystems on a small scale. [expand on other topics you have learned]

## II. Purpose

The purpose of this experiment was to study, on a small scale, the interaction between a terrestrial ecosystem and an aquatic one by creating an EcoBottle, which contained a terrestrial, decomposition, and aquatic chamber. The question was whether or not the two ecosystems would be self sustaining, each yielding the necessary products in order to keep all the species in both ecosystems alive. Since earth is similar to a giant EcoBottle with terrestrial and aquatic ecosystems of many different sizes constantly interacting, this lab helps demonstrate how earth sustains life.

Some of the independent variables in this lab included the type of species added to the bottle: the type of aquatic animal and plant and the type of terrestrial animal and plant. The types of bottles, where the bottles are kept, and the time for which the experiment is conducted are also independent variables. The dependent variables include the survival of the species, or more specifically, the oxygen content of the water, the temperature, the pH, the ammonia content, etc. [are there any questions that you wish to answer in the experiment?]

## III. Hypothesis

If the plants ( aquatic and terrestrial ) survive, then the fish and worms will be able to survive due to them. [be specific here. The “due to them” needs to be clarified]

#### IV. Materials

- 3 Plastic 2L Bottles
- Soil
- 3 worms
- 1 terrestrial plant
- Small pebbles
- Tap Water
- 1 Betta Fish ( Sergei )
- Dechlorinator
- 1 Aquatic plant
- Duckweed
- Decomp ( Leaves, Twigs, Orange Peel, Apple Peel, etc. )
- Probes ( Temperature & Dissolved Oxygen )
- Testing Kits ( pH, Nitrogen, Ammonia )
- Tape
- Scissors
- Laptop

#### V. Procedures

The EcoColumn used in this experiment consists of three parts. The first part, the terrestrial chamber, is created by cutting the bottom off of one of the plastic bottles and turning it neck down. Enough soil to plant the terrestrial plant is then added ( about  $\frac{1}{4}$  of the bottle ) and then the plant is planted. Worms are then added, the plant is watered, and the bottom is sealed back on with tape. The decomposition chamber is cut similarly, but filled with all the decomp: the leaves, the twigs, the fruit peels, etc. The terrestrial chamber is then placed on top and sealed with tape instead of replacing the bottom of the decomposition chamber. The aquatic chamber is created by cutting the top off of a third bottle, adding pebbles ( about  $\frac{1}{4}$  of the bottle ), planting the aquatic plant, adding ( dechlorinated ) water ( almost to the top of the bottle ), placing the

fish, and adding about a tea-spoon of duckweed. Finally, the terrestrial/decomposition chambers are added on top of the aquatic chamber instead of replacing the top, however, the aquatic chamber is not sealed off

For instructions on how to carry out the water tests, refer to the instructions included in each of the water testing kits.

## VI. Results

### Qualitative Data ( Observations )

Day 1 – 10/11/2010

Some condensation is occurring in the terrestrial chamber. The earthworms are somewhere inside the soil, not visible. The decomposition chamber is starting to smell, so today will be the last time opening it. The plants seem to be thriving, and the fish is swimming happily. The duckweed is green and floating on top of the water in the aquatic chamber.

Day2 – 10/15/2010

Things seem to be unchanged. There are larger amounts of condensation in the terrestrial chamber and also in the decomposition chamber. Some mold is appearing in the decomposition chamber. The terrestrial plant may have grown a bit as the leaves are now firmly pushing against the top of the chamber. The fish is alive and swimming, but no sign of the earthworms.

Day 3 – 10/19/2010

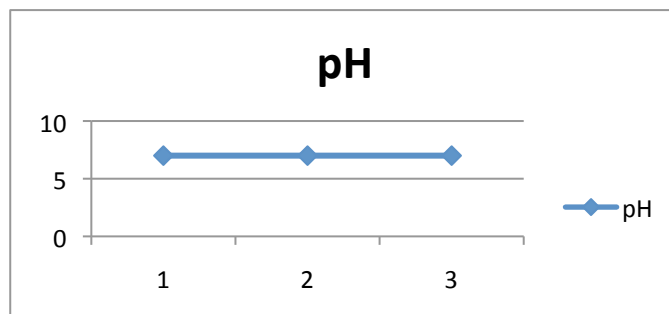
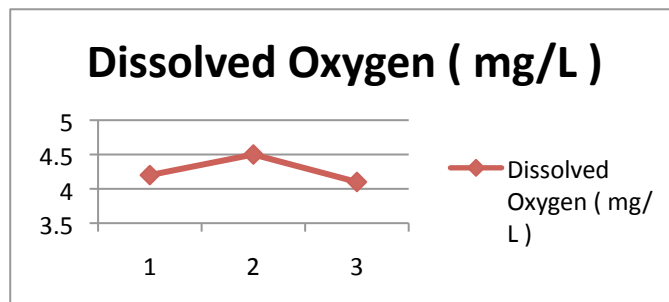
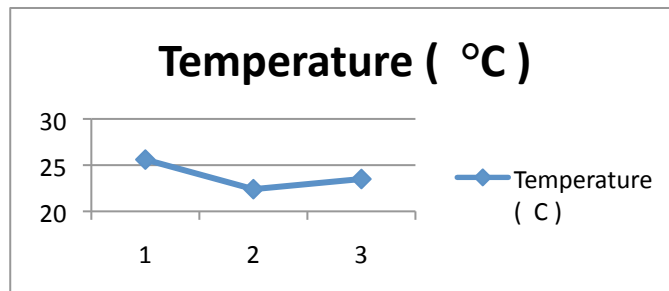
There is condensation in both the terrestrial chamber and the decomposition chamber. The water in the aquatic chamber seems slightly yellow. There is no sign of the earthworms, but the fish is still alive and well. The terrestrial plant is still green with no dead leaves. Some

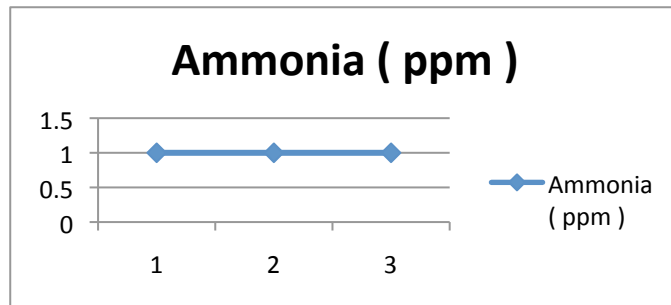
duckweed is still floating in the aquatic chamber. The decomposition chamber has increased mold, the only color still distinguishable being the orange of the orange peel.

### Quantitative Data

Table 1: Test Results – Day 1 through 3 [include dates here as well]

	Day 1	Day 2	Day 3
Temperature ( °C )	25.6	22.4	23.5
Dissolved Oxygen ( mg/L )	4.2	4.5	4.1
pH	6.5-7	6.5-7	6.5-7
Ammonia ( ppm )	1	1	1





## V. Analysis

The data collected throughout the experiment is indicative of a good environment for the aquatic animal ( the fish ). The temperature varied only slightly, between 22 and 25 degrees Celsius most probably due to the fact that the bottle changed locations. The dissolved oxygen level in the water was high enough for the fish to survive; therefore the aquatic plant must have been doing its job photosynthesizing. The pH of the water remained constant around neutral ( pH = 7 ) throughout the experiment, which is great for the well being of Sergei. The ammonia content also remained constant and relatively low, at around 1 ppm, indicating that the water remained relatively clean and non-toxic to the fish. Also, due to the fact that condensation was present, water must have been cycling, keeping the plant inside the terrestrial chamber alive by providing a mini water cycle. Since Sergei and the plants survived, I believe it can be assumed that the conditions observed were favorable and that the mini-ecosystem served its purpose of becoming self-sustaining.

## VI. Conclusion

The purpose of the experiment was to observe if the terrestrial and aquatic ecosystems would be self-sufficient, that is to say, would support the species in each chamber: the fish, the

earthworms, and the two types of plants. My hypothesis appears to be correct. Both the aquatic plant and the terrestrial plant survived. It was determined that the aquatic plant was responsible for the high dissolved oxygen level in the water that allowed the fish to live, therefore, since the plant survived throughout the entire experiment, the fish was able to survive. The same was probably true of the earthworms, despite the fact that they were 'underground' for the duration of the experiment and it was more difficult to determine why they remained alive since the terrestrial chamber was not tested.

There are several factors that might have lead to inaccurate or varying answers. First of all, the EcoBottle did not remain in the same location for the duration of the experiment. The two different rooms it was held in received different amounts of sunlight and were of different sizes, and therefore they had different temperatures. Also, another factor that might have affected the results is that for some of the tests, such as the Ammonia tests, there was not always enough time to carry out the test waiting out the required time for each portion. This might have affected the actual outcome of the test. Finally, the variation in data in my EcoBottle compared to others might have been due to the type of plants I chose. In particular the aquatic plant seemed to be much more effective at providing the fish with oxygen then some of the plants of other people.

Personally, some of the questions I would have to follow up on this experiment would be what would occur in the experiment was continued over a longer period of time. Would the ammonia content of the water have increased to the point where the water would no longer have been habitable for the fish? Would the duckweed have survived more than a week to provide food for the fish? Also what would occur if the three chambers were opened to one another (since in my experiment I did not allow the decomposition chamber to open into the aquatic one)? [good conclusion]

The result might have been affected by many different outside factors, such as whether I was careful enough to clean all the instruments and the type and resilience of the species I chose to put in the EcoBottle, but with the data from this experiment, it seems that it is possible to create a mini, self-sustaining ecosystem.

Final grade = 95